DETAILED ACTION

1. This is the sixth Office Action based on the 10/673,775 application filed 9/29/2003. Claims 6, 7, 9-11, 13, 14, 16-18, 20, 21, and 23-28 are currently pending and have been considered below. Claims 1-5, 8, 12, 15, 19, and 22 have been cancelled.

Interview Summary

2. After getting approval from his supervisor, the examiner faxed proposed claim amendments to the attorney for the applicant on 4/9/2010, and called the attorney for the applicant on 4/12/2010 to discuss the proposed claim amendments. The reason for the proposed claim amendments was to put the claims in condition for allowance over the Chi and Chi et al. references, as well as the other art of record. On 4/29/2010 the examiner spoke with the attorney who confirmed that the applicant had approved the claim amendments. The amendments are made herein as an Examiner's Amendment.

EXAMINER'S AMENDMENT

3. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Adam Rehm on 4/29/2010.

The claims of the application have been amended as follows:

1-5. (Cancelled)

6. (Currently Amended) A ~~solid-state~~ complementary metal-oxide semiconductor type solid-state image pickup device, comprising:

a semiconductor substrate having a plurality of well regions formed thereon; and

a pixel unit having a plurality of pixels in a plurality of pixel rows on the semiconductor substrate, each pixel in ~~the pixel unit~~ a pixel row of said plurality of pixel rows including

(a) a photoelectric conversion element formed in ~~each~~ a well region of said plurality of well regions to receive light and produce a signal charge in accordance with an amount of the received light;

(b) a readout section formed in said well region ~~each of said plurality of well regions~~ to read out the signal charge produced by said photoelectric conversion element at a predetermined readout timing;

(c) a node connected to the photoelectric conversion element through the readout section, and

(d) a voltage control unit to apply a variable substrate bias voltage to said well region ~~each of said plurality of well regions~~ dependent upon the read out of the signal charge by said readout section,

wherein the well regions of the plurality of well regions are electrically isolated from each other along each pixel row of the plurality of pixel rows, and

wherein the voltage control unit varies the variable substrate bias voltage to said well region while the readout section reads out the signal charge.

7. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 6, wherein said plurality of ~~pixel rows are~~ pixels is arranged in a two-dimensional array on said semiconductor substrate.

8. (Cancelled)

9. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 7, wherein an independent substrate bias voltage is applied to each well region of the plurality of well regions ~~for each of the plurality of rows~~.

10. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 6, wherein each well region of said plurality of well regions ~~are~~ is a p-type well region and the substrate bias voltage is a negative voltage.

11. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 6, wherein each pixel of said solid-state image pickup device ~~each pixel~~ also includes a pixel transistor connected to said photoelectric conversion element through said node for converting the signal charge read out from said photoelectric conversion element into an electric signal and outputting the electric signal to a signal line.

12. (Cancelled)

13. (Currently Amended) A complementary metal-oxide semiconductor type solid-state image pickup device, comprising:

a semiconductor substrate having a plurality of well regions formed thereon; and

a pixel unit having a plurality of pixels in a plurality of pixel rows on the semiconductor substrate, each pixel in ~~the pixel unit~~ a pixel row of said plurality of pixel rows including

(a) a photoelectric conversion element formed in ~~each~~ a well region of said plurality of well regions to receive light and produce a signal charge in accordance with an amount of the received light;

(b) a readout section formed in said well region ~~each of said plurality of well regions~~ to read out the signal charge produced by said photoelectric conversion element at a predetermined readout timing;

(c) a node connected to the photoelectric conversion element through the readout section, and

(d) voltage control means to apply a substrate bias voltage to said well region ~~each of said plurality of well regions~~ and change the substrate bias voltage during a storage period of the signal charge by said photoelectric conversion element,

wherein the well regions of the plurality of well regions are electrically isolated from each other along each pixel row of the plurality of pixel rows, and

wherein the voltage control means varies the substrate bias voltage to said well region while the readout section reads out the signal charge.

14. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 13, wherein said plurality of ~~pixel rows are~~ pixels is arranged in a two-dimensional array on said semiconductor substrate.

15. (Cancelled)

16. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 14, wherein an independent substrate bias voltage is applied to each well region of the plurality of well regions ~~for each of the plurality of rows~~.

17. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 13, wherein each well region of said plurality of well regions ~~are~~ is a p-type well region and the substrate bias voltage is a negative voltage.

18. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 13, wherein each pixel of said plurality of pixels also includes a pixel transistor connected to said photoelectric conversion element through said node for converting the signal charge read out from said photoelectric conversion element into an electric signal and outputting the electric signal to a signal line.

19. (Cancelled)

20. (Currently Amended) A method to drive a solid-state image pickup device including (a) a semiconductor substrate having a plurality of well regions formed thereon; and (b) a pixel unit including a plurality of pixels in a plurality of pixel rows on the semiconductor substrate, each pixel in ~~the pixel unit~~ a pixel row of said plurality of pixel rows including (i) a photoelectric conversion element formed in ~~each~~ a well region of said plurality of well regions to receive light and produce a signal charge in accordance with an amount of the received light, (ii) a readout section formed in said well region ~~each of said plurality of well regions~~ to read out the signal charge produced by said photoelectric

conversion element at a predetermined readout timing, (iii) a node connected to the photoelectric conversion element through the readout section, and (iv) voltage control means to apply a substrate bias voltage to said well region ~~each of said plurality of well regions~~ and change the substrate bias voltage during a storage period of the signal charge by said photoelectric conversion element, said method comprising the steps of:

converting light to [[a]] the signal charge;

storing said signal charge during ~~a charge~~ the storage period; and

~~applying a predetermined~~ varying the substrate bias voltage to said well region ~~each of said plurality of well regions that is variable dependent upon the signal charge read out by~~ while said readout section reads out the signal charge during ~~said~~ a readout period,

wherein the well regions of the plurality of well regions are electrically isolated from each other along each pixel row of the plurality of pixel rows.

21. (Currently Amended) The ~~driving~~ method to drive a ~~for a complementary metal-oxide-semiconductor type~~ solid-state image pickup device according to claim 20, wherein said photoelectric conversion element is provided for each pixel of said plurality of pixels, and said plurality of ~~pixel rows are~~ pixels is formed in a two-dimensional array on said semiconductor substrate.

22. (Cancelled)

23. (Currently Amended) The ~~driving~~ method to drive a ~~for a complementary metal-oxide-semiconductor type~~ solid-state image pickup device according to claim 21, wherein an independent substrate bias voltage is applied to each well region of the plurality of well regions ~~for each of the plurality of rows~~.

24. (Currently Amended) The ~~driving~~ method to drive a ~~for a complementary metal-oxide-semiconductor type~~ solid-state image pickup device according to claim 20, wherein each well region of said plurality of well regions ~~are~~ is a p-type well region and the substrate bias voltage is a negative voltage.

25. (Currently Amended) A method for driving a complementary metal-oxide semiconductor type solid-state image pickup device including (a) a semiconductor substrate having a plurality of well regions formed thereon; and (b) a pixel unit including a plurality of pixels in a plurality of pixel rows on the semiconductor substrate, each pixel in ~~the pixel unit~~ a pixel row of said plurality of pixel rows including (i) a photoelectric conversion element formed in ~~each~~ a well region of said plurality of well regions to receive light and produce a signal charge in accordance with an amount of the received light, (ii) a readout section formed in said well region ~~each of said plurality of well regions~~ to read out the signal charge produced by said photoelectric conversion element at a predetermined readout timing, (iii) a node ~~to connect~~ connected to the photoelectric conversion element through the readout section, and (iv) voltage control means to apply a substrate bias voltage to said well region ~~each of said plurality of well~~

~~regions~~ and change the substrate bias voltage during a storage period of the signal charge by said photoelectric conversion element, said method comprising the steps of:

converting light to [[a]] the signal charge;

storing said signal charge during ~~a charge~~ the storage period; and

~~applying a~~ varying the substrate bias voltage to said well region ~~each of said plurality of well regions~~ while said readout section reads out the signal charge and changing the substrate bias voltage during said storage period of the signal charge by said photoelectric conversion element,

wherein the well regions of the plurality of well regions are electrically isolated from each other along each pixel row of the plurality of pixel rows.

26. (Currently Amended) The ~~driving~~ method for driving a complementary metal-oxide semiconductor type solid-state image pickup device according to claim 25, wherein said photoelectric conversion element is provided for each pixel of said plurality of pixels, and said plurality of ~~pixel rows are~~ pixels is formed in a two-dimensional array on said semiconductor substrate.

27. (Currently Amended) The ~~driving~~ method for driving a complementary metal-oxide semiconductor type solid-state image pickup device according to claim 25, further comprising:

reducing a readout voltage by applying the substrate bias voltage synchronized with charge transfer.

28. (Currently Amended) The complementary metal-oxide semiconductor type solid-state image pickup device according to claim 6, wherein each well region of the plurality of well regions ~~include~~ includes a plurality of pixels.

Remarks

4. In view of the above Examiner's Amendment, all rejections of and objections to the claims are withdrawn.

Allowable Subject Matter

5. Claims 6, 7, 9-11, 13, 14, 16-18, 20, 21, and 23-28 are allowed. They are renumbered as claims 1-5, 7-18, and 6 respectively.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to DENNIS HOGUE whose telephone number is (571) 270-5089. The examiner can normally be reached on Mon. - Thurs., 8:00 AM - 5:00 PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lin Ye can be reached on (571) 272-7372. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

DH
Examiner
4/30/2010

/Jason Whipkey/
Primary Examiner, Art Unit 2622